

**2. SYSTEM LEVEL OF SERVICE
ELEMENT
(THE CMP ROADWAY SYSTEM, LEVEL
OF SERVICE STANDARDS,
AND LEVEL OF SERVICE PROCEDURES)**

The first element of the CMP defines the CMP roadway system, establishes traffic level of service standards on the system, and prescribes procedures for computing traffic levels of service. This chapter is organized to indicate legislative requirements, objectives/policies/actions, and related processes.

2.A LEGAL REQUIREMENTS

California Government Code Section 65089. (b) (1) states that the Level of Service Element shall contain:

"(A) Traffic level of service standards established for a system of highways and roadways designated by the agency. The system shall include at a minimum all State highways and principal arterials. No highway or roadway designated as a part of the system shall be removed from the system. All new State highways and principal arterials shall be designated as part of the system. Level of service (LOS) shall be measured by Circular 212, (or by the most recent version of the Highway Capacity Manual), or by a uniform methodology adopted by the agency which is consistent with the Highway Capacity Manual. The determination as to whether an alternative method is consistent with the Highway Capacity Manual shall be made by the regional agency, except that the department shall make this determination instead if either (i) the regional agency is also the agency, as those terms are defined in Section 65088.1, or (ii) the department is responsible for preparing the regional

transportation improvement plan for the county.

(B) In no case shall the LOS standards established be below the level of service E or the current level, whichever is farthest from level of service A. When the level of service on a segment or at an intersection fails to attain the established level of service standard, a deficiency plan shall be adopted pursuant to Section 65089.4."

2.B LEVEL OF SERVICE DEFINITIONS

The current technical guide to the evaluation of roadway level of service is the 2000 Highway Capacity Manual (HCM) . The 2000 HCM defines level of service as a qualitative measure which describes operational conditions within a traffic stream, generally in terms of such factors as speed and travel time, freedom to maneuver, traffic interruptions, comfort and convenience, and safety. The criteria used to evaluate LOS conditions vary based on the type of roadway and whether the traffic flow is considered interrupted or uninterrupted.

The definitions of level of service for uninterrupted flow (flow unrestrained by the existence of traffic control devices) can be summarized as follows:

- LOS A represents free flow. Individual users are virtually unaffected by the presence of others in the traffic stream.
- LOS B is in the range of stable flow, but the presence of other users in the traffic stream begins to be noticeable. Freedom to select desired speeds is relatively unaffected, but there is a slight decline in the freedom to maneuver.
- LOS C is in the range of stable flow, but marks the beginning of the range of flow in which the operation of individual users

becomes significantly affected by interactions with others in the traffic stream.

- LOS D represents high-density but stable flow. Speed and freedom to maneuver are severely restricted, and the driver experiences a generally poor level of comfort and convenience.
- LOS E represents operating conditions at or near the capacity level. All speeds are reduced to a low, but relatively uniform value. Small increases in flow will cause breakdowns in traffic movement.
- LOS F is used to define forced or breakdown flow. This condition exists wherever the amount of traffic approaching a point exceeds the amount which can traverse the point. Queues form behind such locations.

The definitions of level of service for interrupted traffic flow (flow restrained by the existence of traffic signals and other traffic control devices) differ slightly depending on the specific element of the roadway being considered, e.g., signalized intersections versus arterial segments. The level of service criteria for signalized intersections are:

- LOS A - describes operations with average intersection stopped delay (how long a driver must wait at a signal before the vehicle can begin moving again) of five seconds or less.
- LOS B - average stopped delay between 5.1 and 15.0 seconds per vehicle.
- LOS C - average stopped delay between 15.1 and 25.0 seconds per vehicle.
- LOS D - average stopped delay between 25.1 and 40.0 seconds per vehicle.

- LOS E - average stopped delay between 40.1 and 60.0 seconds per vehicle.
- LOS F - average stopped delay greater than 60.0 seconds per vehicle.

An intersection is also designated as F when the volume/capacity ratio of the critical movements is equal to or greater than 1.0.

The level of service criteria for arterial segments with free flow speeds (typical traffic speed between intersections) of 40 miles per hour are:

- LOS A - arterial speeds (including intersection delay) greater than 35 mph.
- LOS B - arterial speeds 28.0 to 34.9 mph
- LOS C - arterial speeds 22.0 to 27.9 mph
- LOS D - arterial speeds 17.0 to 21.9 mph
- LOS E - arterial speeds 13.0 to 16.9 mph
- LOS F - arterial speeds less than 13.0 mph

The level of service criteria for arterials with typical free flow speeds of 33 miles per hour provide for lower thresholds of speed than those shown above. Level of service criteria for typical free flow speeds of 27 mph should not be used for principal arterials.

2.C LOS STANDARD DEFINITION AND PURPOSE

California Government Code Section 65088.1(j) discusses the meaning of the CMP level of service standard:

‘Level of service standard’ is a threshold that defines a deficiency on the congestion management program highway and roadway system which requires the preparation of a

deficiency plan. It is the intent of the Legislature that the agency shall use all elements of the program to implement strategies and actions that avoid the creation of deficiencies and to improve multimodal mobility.”

2.D OBJECTIVES, POLICIES, AND ACTIONS

The objectives express the element's basic intent. Policies are guidelines to achieve the objective. Actions are the steps to be taken by the appropriate agencies to implement policies and advance toward the objectives.

Objective 2.1 Maintain and, as needed, update the CMP system of highways and roadways.

Policy 2.1.1 - Use the functional definitions in this chapter and input from local jurisdictions as guidance for the inclusion of additional or new principal arterials on the CMP roadway system in the future.

Action Implement Policy 2.1.1.

RESPONSIBILITY: Local jurisdictions and the CMA Board.

Objective 2.2 Maintain and apply the level of service analysis procedures that best reflect actual system performance.

Policy 2.2.1 - Establish the most current version of the Highway Capacity Manual, published by the Transportation Research Board, as the standard for level of service analysis procedures for use in all CMP related LOS computations.

Action Implement Policy 2.2.1.

RESPONSIBILITY: CMA Board and local jurisdictions.

Action Provide supporting materials and data to local jurisdictions to allow for the most effective application of the procedures.

RESPONSIBILITY: CMA coordinates, Caltrans and local jurisdictions supply data.

Action Provide a description of the adopted capacity analysis procedures, update the procedures as required, and distribute the information to local jurisdictions and Caltrans.

RESPONSIBILITY: CMA

Objective 2.3 Set level of service standards that provide a reasonable balance between mobility and the cost of building and operating the transportation system.

Policy 2.3.1 - Establish level of service E or the current level, whichever is farthest from LOS A, as the LOS standard for intersections or segments on the CMP system of roadways.

If the 1992 LOS was F (see Table 2-1), then a 10 percent or more degradation in the quantitative measure used to determine the LOS (such as delay, V/C, or travel speed) will comprise a deficiency, which must be addressed by a deficiency plan.

Action Implement Policy 2.3.1.

RESPONSIBILITY: CMA Board and local jurisdictions.

2.E BENEFITS OF THE SYSTEM LEVEL OF SERVICE PROGRAM

The CMP system level of service element provides the following benefits:

- Defines a system of roadways that is a basis for implementing the provisions of the Congestion Management Program.
- Serves as a basis for other countywide transportation planning and programming activities.
- Creates a set of consistent, quantitative procedures for defining system deficiencies, helping to evaluate the impacts of land use decisions, and evaluating potential roadway improvements. The procedures provide a tool for evaluating the balance between land use and transportation system capacity.
- Provides a definition of "principal arterial" to be used in updates of the CMP system and for other transportation planning purposes.

2.F CMP ROADWAY SYSTEM

2.F.1 DEFINITION OF PRINCIPAL ARTERIAL

The CMP system is required to include, at a minimum, all State highways and principal arterials. The system to be used for CMP modeling (discussed in Chapter 8) is required to include the System of Regional Significance identified within the Regional Transportation Plan. "Principal arterial" is not defined in the CMP legislation. As part of the development of the CMP for San Bernardino County, a working definition of principal arterial was developed by CMA staff:

Principal arterials are roadways that are of multi-jurisdictional or regional significance. This means that during both peak and off-peak periods, the roadway is likely to carry traffic across city or county

boundaries, or within a given jurisdiction is likely to carry a significant proportion of non-local traffic. Additional criteria for principal arterials are:

- Freeways, other State highways, and major projections of those roadways.
- Major roadways leading to or from a freeway interchange.
- Major roadways that provide direct links between freeways and State highways.
- A major roadway that is designated a principal arterial by the local jurisdiction.

This definition is provided for guidance only. The CMP principal arterials are non-State roadways shown in Figures 2-1 through 2-3. The addition of other roadways may be requested by local jurisdictions.

2.F.2 PROCESS OF CMP ROADWAY SYSTEM DEVELOPMENT

The CMP roadway system in San Bernardino County was developed in the following manner:

- The existing classifications of roadways were reviewed. This included a functional classification conducted by FHWA in the early 1980s, the System of Regional Significance defined in the 1989 Regional Mobility Plan, and a sample of classifications in local jurisdiction general plans.
- An initial "working network" was defined by the CMA staff. The initial roadway system included the roadways defined

"principal arterial" by FHWA and any additional roadways also defined by the System of Regional Significance. This served as the basis for preliminary review and recommendations by local jurisdictions and for the collection and analysis of traffic data.

- Meetings and discussions were held with local jurisdictions to review and refine the system. Both deletions and additions to the "working system" were made as a result of those reviews.
- Level of service analyses were conducted on the "working system." This provided additional perspective on the magnitude of congestion problems and brought into focus some of the implications of having a less extensive or more extensive roadway system.
- The roadway system was refined further on the level of service analysis results to reflect local staff input.
- The system was then reviewed and approved by local elected officials.
- Any new State highway will be included in the CMP system. Any new roadway designated as a principal arterial by local jurisdictions, and approved by the CMA Board, will also be included in the CMP system.

2.F.3 THE CMP SYSTEM FOR SAN BERNARDINO COUNTY

Figures 2-1, 2-2, and 2-3 show the CMP system countywide, within the Valley Region, and in the Victor Valley Region, respectively. The mileage characteristics of the roadways are shown in Figure 2-4.

Much of the CMP system mileage is in rural areas where the need for monitoring and the potential for system capacity deficiencies are reduced.

The CMP uses the term "CMP intersections" to refer to the intersection of two CMP roadways. "Key intersections" include all CMP intersections plus others identified by local jurisdictions as being important to maintaining mobility on the CMP system. For the CMP, intersections operating at level of service D or lower will normally be considered key intersections, in addition to the intersections of two CMP roadways. A listing of key intersections is presented in Appendix A. There are approximately 370 key intersections on the CMP system. The term "CMP segment" is defined as the roadway segment between two CMP intersections or, for limited access highways, the segment between two interchanges. A CMP segment will comprise a unit of measurement for those procedures not involving intersections.

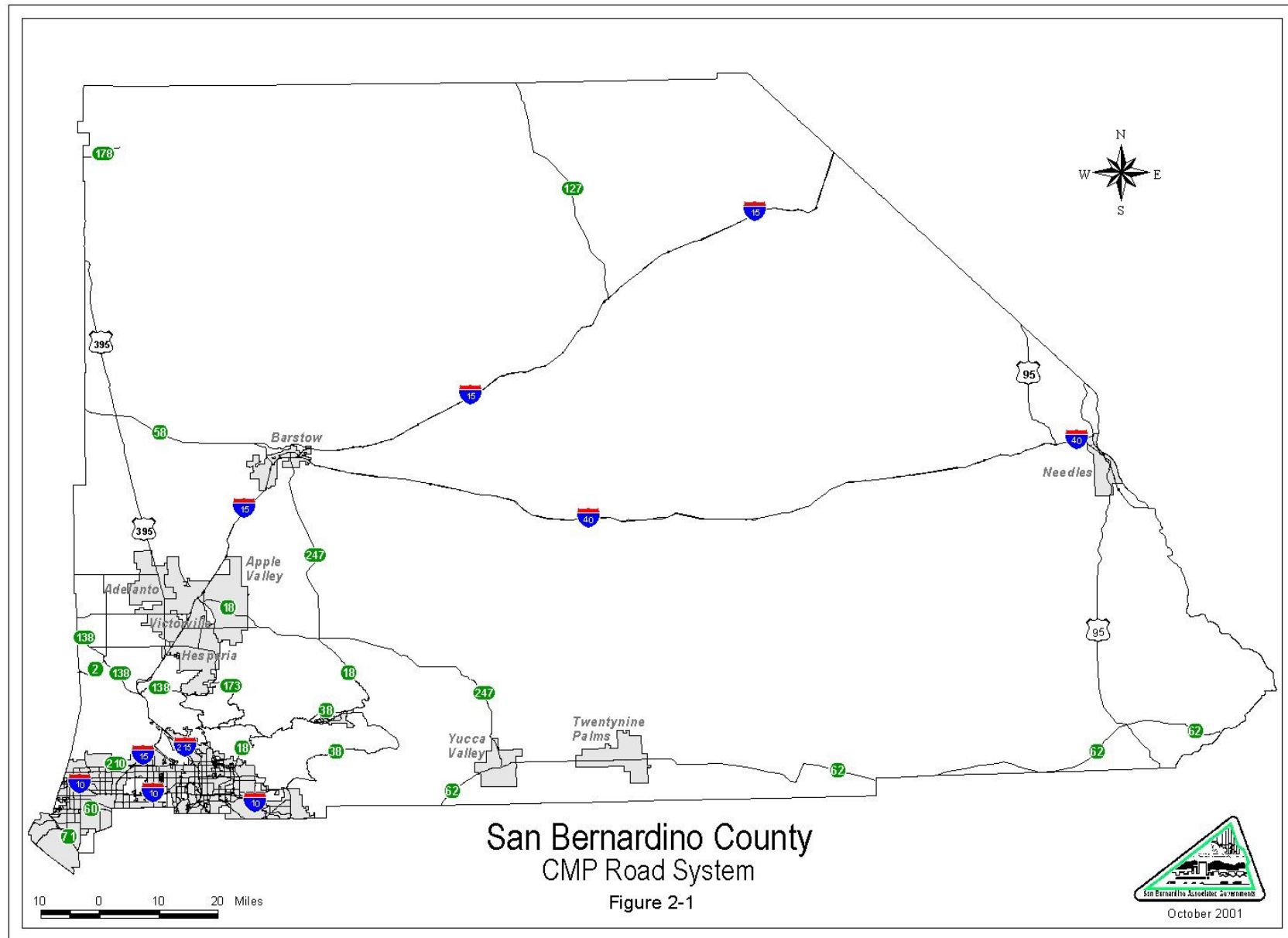
2.G CMP LEVEL OF SERVICE STANDARDS

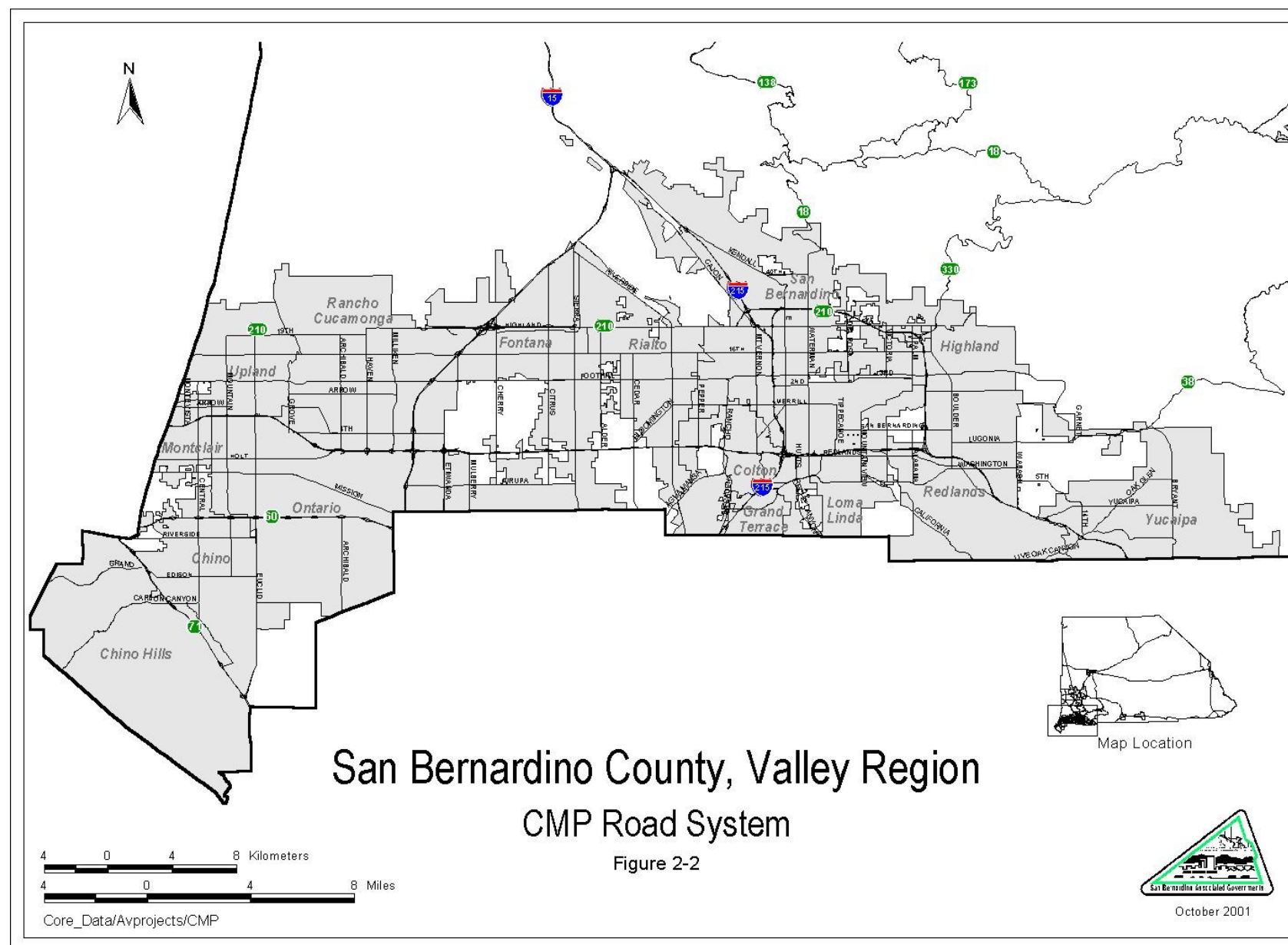
The CMP level of service standards apply to AM and PM weekday peak-hours, except in recreational areas such as Big Bear Lake, where average traffic peaks occurring on weekends will be used. For the CMP roadway system, the level of service standard shall be E for all segments and intersections except those designated level of service F, as listed in Table 2-1. Table 2-1 also shows portions of the CMP system determined to be deficient by the 1993 or 1995 CMP monitoring programs. Each deficient portion of the CMP system identified in Table 2-1 must be addressed through the deficiency process stipulated in Chapter 8 of this document.

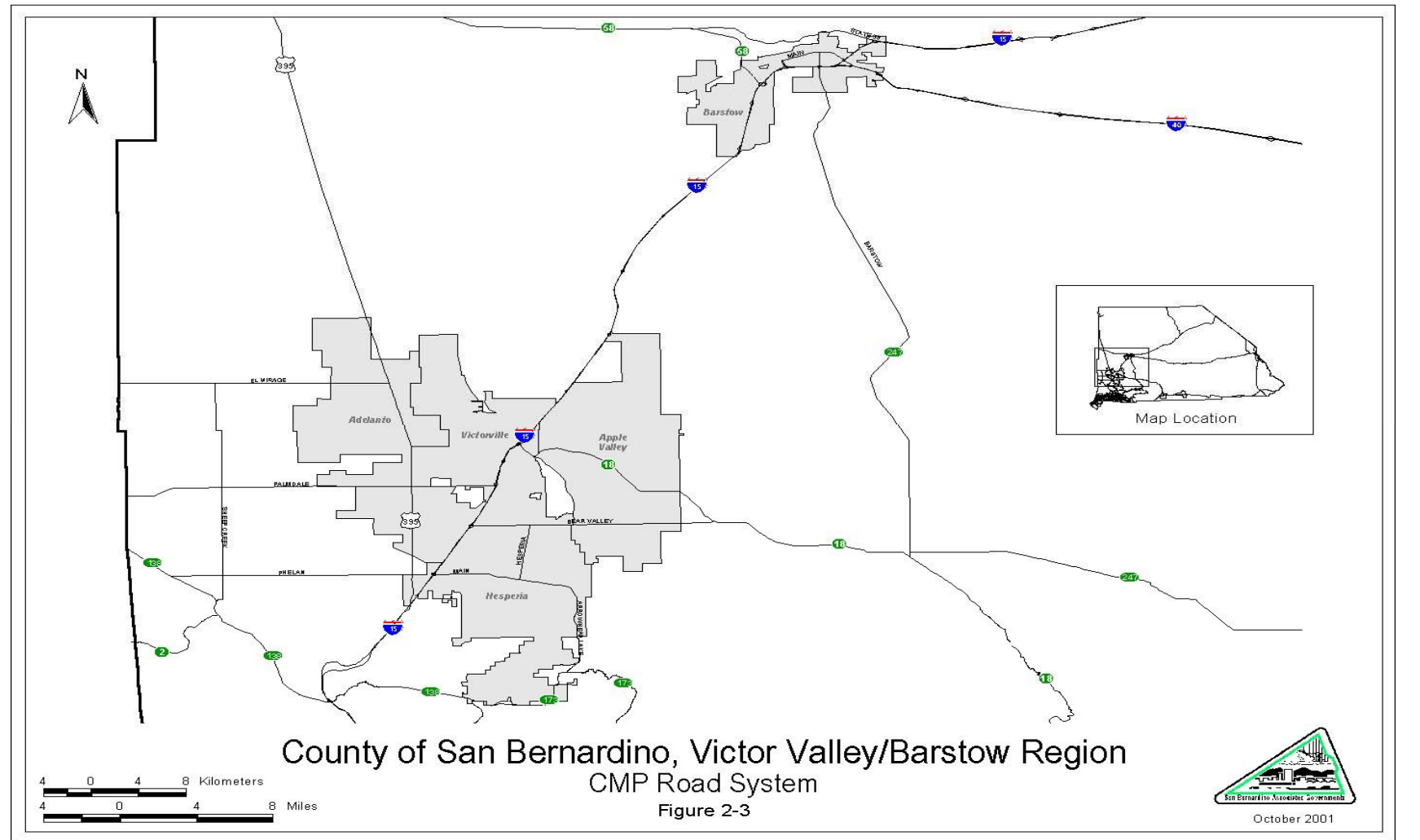
Intersections and segments designated level of service F were computed to be F for either the AM or PM weekday peak-hour.

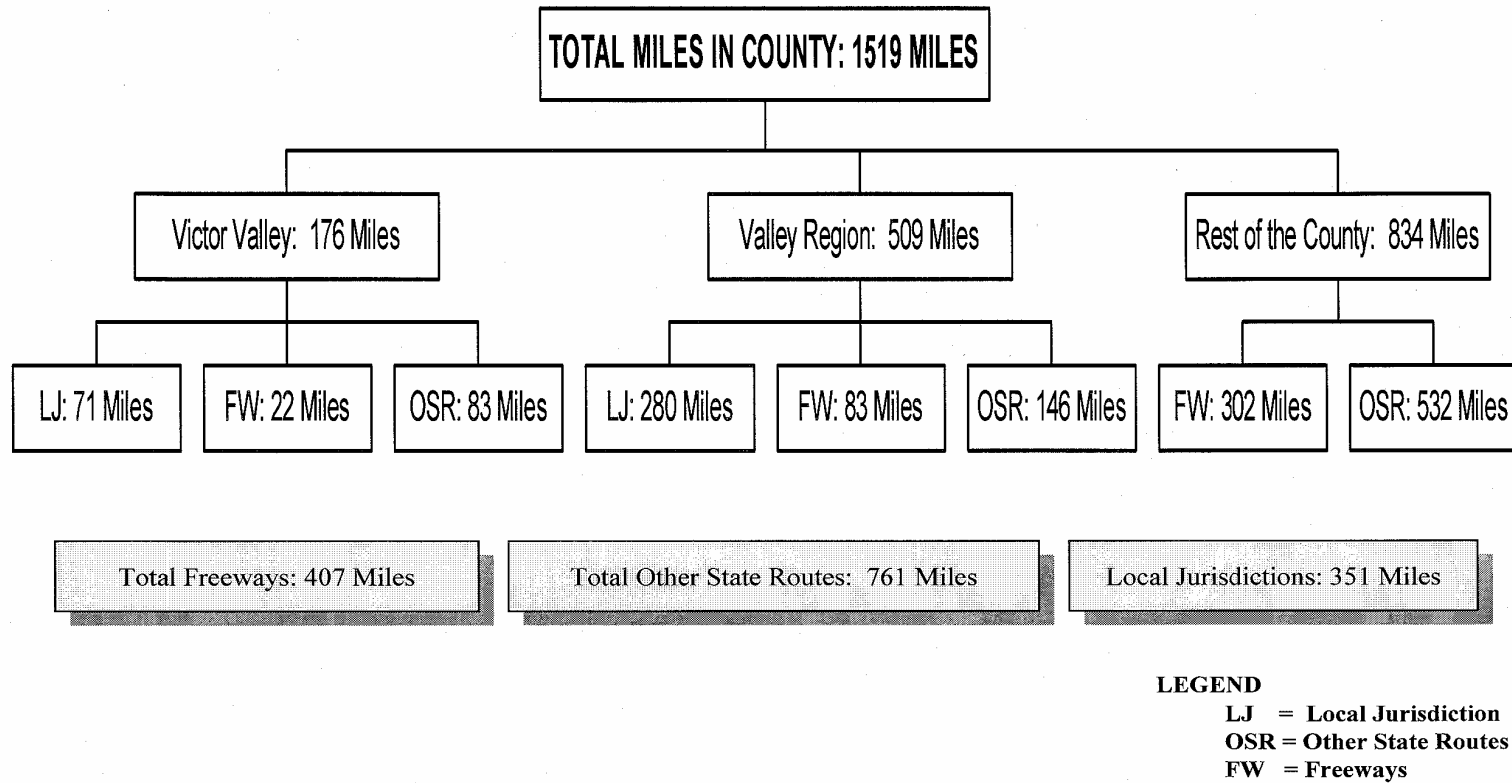
Other provisions of the CMP level of service standards are:

- Any facility with a LOS F standard in 1992 will be defined to have exceeded its LOS standard if the numerical value of level of service deteriorates by more than 10 percent (see Table 2-1). This provision is included to not permit dismissal of a serious level of service problem just because it is at the lowest letter grade in level of service. A table of current level of service values for intersections and segments with LOS F is presented in Appendix A.









Mileage Characteristics of the San Bernardino County CMP Network

Figure 2-4

Table 2-1

The following is a list of intersections which have been determined to be at LOS F in 1992 based on the average stopped delay per vehicle, or on a v/c ratio for the critical movements equal to or greater than 1.00:

	<u>Local Jurisdiction</u>	<u>Average Stopped Delay/Vehicle</u>	<u>Critical v/c ≥ 1.00</u>
Anderson & Barton	Loma Linda		X
California & Redlands	Loma Linda-Rdlands-SBdno Co.	X	
Mountain View & I-10 (EB)	Loma Linda		X
Grove & Holt	Ontario	X	X
Mountain & Holt	Ontario	X	X
Mountain & Mission	Ontario		X
Euclid & Holt	Ontario		X
Archibald & Foothill	Rancho Cucamonga	X	X
Carnelian & Baseline	Rancho Cucamonga	X	X
Vineyard & Foothill	Rancho Cucamonga	X	X
Grove & Foothill	Rancho Cucamonga-Upland		X
Alabama & Redlands	Redlands		X
Waterman & Hospitality	San Bernardino	X	X
Euclid & Arrow Hwy (10 th)	Upland		X
Central & Foothill	Upland	X	X
Euclid & 19 th	Upland	X	X
Euclid & 16 th	Upland	X	X
Euclid & Foothill	Upland	X	X
Mountain & Foothill	Upland	X	X

**Table 2-1
(continued)**

1992 Segments Designated LOS F:

Freeways

- I-10 Westbound, Milliken Avenue to Central Avenue
- I-10 Westbound, Waterman Avenue to EB Rt-30
- I-10 Eastbound, Central Avenue to Milliken Avenue
- I-10 Eastbound, NB Rt-15 to SB Rt-15
- I-10 Eastbound, SB Waterman to California Street
- SR-60 Westbound, Milliken Avenue to Central Avenue
- SR-60 Eastbound, Central Avenue to Milliken Avenue
- I-215 Northbound, Inland Center to Route 30/Highland Avenue

Valley East/West Arterial Segments

- Foothill between Mountain and Archibald

Valley North/South Arterial Segments

- Citrus between Slover and Valley
- Cedar between Slover and Valley
- Mt. View between Barton and Redlands
- Mountain Ave. between Mission and Holt

Victor Valley Arterial Segments

- Bear Valley Rd. between Amargosa and Mariposa
- Bear Valley Rd. between Hesperia and Peach
- SR-18 between I-15 (North) and Stoddard Wells Rd.

2.H CMP LEVEL OF SERVICE ANALYSIS PROCEDURES

The procedures in the 2000 Highway Capacity Manual adopted by the Transportation Research Board serve as the level of service calculation procedures for the San Bernardino County CMP. Provisions are made, however, for more advanced analysis techniques to be adopted in the future, such as traffic signal timing programs for arterials, and freeway simulation models for limited access facilities. The use of these advanced simulation techniques will be at the discretion of each local agency.

The discussion below provides an overview of the procedures and their application in San Bernardino County. Appendix A provides background information on the procedures and their application to the CMP. Chapter 7 describes the data collection and monitoring procedures to be applied in maintaining a record of existing levels of service and reporting them in the annual CMP. In some cases, the transition to more advanced techniques is provided for in future CMP years, at the option of local agencies. With the exception of Big Bear Valley, all analyses for the annual level of service determination are to be conducted for the AM and PM weekday peak-hours, at a minimum. For Big Bear Valley, analyses shall be conducted for weekend recreation peak-hours, at a minimum.

- **Signalized Intersections.** Use the operations method in Chapter 16 of the 2000 Highway Capacity Manual for the AM and PM peak-hours to establish the LOS for all "key" intersections. The definition of key intersection is provided in the glossary. The definition of LOS F used for the CMP is average stopped delay per vehicle greater than 80 seconds or a volume/capacity ratio equal to or

greater than 1.0 for the critical movements. Standard values for saturation flow rate, signal progression, and related factors are provided in Appendix C along with the guidelines for Traffic Impact Analysis Reports. Actual measured values for intersection parameters should be used whenever possible. Alternatively, jurisdictions may conduct a direct measurement of vehicle delay, as described in Part III Chapter 16 of the 2000 HCM.

- **Urban and Suburban Arterial Segments.** This analysis is conducted for a CMP link within an urban area. The definition of a CMP segment is provided above in this chapter and in the glossary. The analyses are to be conducted in the peak direction only for the AM and PM peak-hours. Two alternative methods are provided for urban and suburban arterial level of service, both based on Chapter 15 of the 2000 HCM. Either method may be used, at the option of the local jurisdiction or Caltrans. The first method is direct measurement of speed through moving car travel time runs. This method may be particularly important for CMP segments with levels of service close to the established standard. A minimum of four travel time runs distributed through the peak-hour is needed. The other method is the calculation of level of service from traffic volume, geometric, and signalization data, as described in Chapter 15 of the HCM. However, because it may be impractical to provide traffic counts for all signalized intersections on each CMP segment (as would be required for full implementation of Chapter 15 procedures), provision is made for a simplification of the procedure. The simplification is based on

a procedure developed for use by the Florida Department of Transportation (FDOT, 1988). Using the procedures described in Chapter 15 of the 2000 HCM, the FDOT procedure presents threshold hourly volumes for estimating the peak hour-peak direction level of service as a function of roadway type, urban area population, and the number of traffic signals per mile. The procedure also provides the generalized assumptions used to establish the threshold volumes. The details of these procedures are provided in Appendix A. This procedure should be considered as a screening method, and travel time runs are recommended for CMP segments within one LOS of the standard.

- **Freeways.** The 2000 HCM procedure for basic freeway segments is to be used for LOS analysis of freeways. The procedures must use the updated per lane capacity values (2300 vehicles per lane per hour) approved by the Transportation Research Board. These new values are based on the updated speed/flow curves and capacity information contained in the new materials for rural multilane highways. For the long-term, the network analysis tool FREQ may be considered for LOS analysis on the freeway network. This will ultimately provide the most comprehensive analysis tool available for the evaluation of traffic growth, roadway improvements, and land development, while maintaining an up-to-date assessment of LOS conditions.
- **Rural Multilane Highways.** Use the updated Chapter 21 materials from the 2000 HCM. There exists a limited number of miles of this roadway type in the CMP roadway system and, as urbanization of the region continues, these miles will probably become fewer.

- **Rural Two-Lane Highways.** The procedure for the LOS evaluation for rural two-lane highways is the 2000 HCM Chapter 20 method. Default values for directional distribution and percent no-passing zones may be used, but should be estimated for specific areas.
- **Roadways with Heavy Recreational Traffic.** Some roadways on the CMP system, particularly those in the mountain region, do not experience their highest traffic peaks during typical AM and PM weekday commuting periods. These roadways tend to carry heavy recreational traffic, which peaks during the weekends. For roadways in the mountain region, the basis for level of service analysis will be the peak-hour for a typical high season weekend. For purposes of the CMP, this is defined as a non-holiday weekend peak in February or March.

2.I SUMMARY OF AGENCY RESPONSIBILITIES

CMA Responsibilities

- Maintain and update the CMP roadway system maps.
- Approve additions to the CMP roadway system based on local recommendations.
- Maintain a functional definition to lend guidance to the addition of new principal arterials on the CMP roadway system.
- Provide supporting data to local jurisdictions to allow for the most effective application of the LOS procedures.

San Bernardino County CMP, 2001 Update

- Provide a description of the adopted capacity analysis procedures, update the procedures as needed through the CMPTAC, and distribute information to local jurisdictions and Caltrans.

Local Jurisdiction Responsibilities

- Provide recommendations to the CMA on CMP roadway system additions.
- Incorporate adopted LOS procedures into analyses conducted for the CMP.

Caltrans Responsibilities

- Incorporate adopted LOS procedures into analyses conducted for the CMP.
- Make data for LOS analysis on State highways available to local jurisdictions and the CMA.

Air District Responsibilities

- Provide input on the air quality implications of decisions on level of service standards and the extent of the CMP roadway system.